THE REPORT OF JOHN SMEATON, ENGINEER,

UPON THE

HARBOUR OF *DOVER*;

TOGETHER WITH

A PLAN OF THE SAID HARBOUR.

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REPORT

THE REPORT OF JOHN SMEATON, Engineer, UPON THE HARBOUR OF *DOVER*.

THIS Harbour appears from old Accounts to have been a national Object for Ages paſt, as being the neareſt Port, and conſequently, from its Situation, the Key between *England* and *France*: On this Account great Sums of Money have been from Time to Time expended in keeping it open, and rendering it as commodious as the Nature of the Situation will admit of; yet, notwithſtanding every Endeavour for this Purpoſe, it ſtill labours under ſome natural Inconveniences, which it is greatly to be wiſhed were removed. For this Purpoſe, at the Deſire of the Right Honourable the Earl of HOLDERNESSE, Lord Warden of the Cinque Ports, I went down to view and examine the Harbour of *Dover* in *February* laſt; where I had every Aſſiſtance the Place would afford.

The Port of *Dover* has in Length of Time gone through many Changes, the Mouth or Entry thereof being at preſent, in a very different Place to what it was within the Compaſs of Record, as appears by Accounts thereof collected by Mr. *Hammond* of *Dover*, with the Peruſal of which he was ſo obliging as to favour me. This great Change has been evidently brought about by the ſame Cauſe that has at all Times been, and ſtill continues to be, its greateſt Annoyance; *viz.* the conſtant Motion of the Beach or Shingle, which by the Action

Action of the Seas is driven Coaſt-ways, from Weſt to Eaſt: for as the *Britiſh* Channel opens to the Weſt, and contracts to the Eaſtward, the Seas are much more violent and heavy from the South-weſtern than from the South-eaſtern Quarter; and in Conſequence, though it may be apprehended, that on violent Storms at South-eaſt, the Shingle may in ſome Degree be moved Weſtward, yet, the general Prevalence being the contrary Way, the moſt apparent and obſervable Motion is Coaſt-ways from Weſt to Eaſt.

This Shingle, or Beach as it is called, conſiſts chiefly of Flints, that ſeem to have originally proceeded from Chalk Cliffs, that inveſt a conſiderable Part of the South Coaſt of *England*; which Cliffs being gradually undermined by the Action of the Seas at the Foot thereof, tumble down, and often in very large Quantities; where by Degrees the Chalk diſſolves, by the Action of the Sun, the Sea, and the Froſts; and the Flints, being broken and inceſſantly rubbed againſt each other, form a conſtant Succeſſion of Beach. This however is obſervable, whether this Succeſſion is to be attributed to the above or any other Cauſe, that an immenſe Quantity of Beach is in a State of continual Motion along the Coaſt, from Weſt to Eaſt, Part of which lodges and fills up every Receſs, where it can be depoſited and lay in Quiet.

This Beach has formerly been the Deſtruction of the old Harbour; and it appears from the above Accounts, that the Mouth has been more than once entirely ſhut up, and has remained ſo for Years; and that the Mouth of the preſent Harbour was originally a Cut through the Beach, to let off the Land-waters pent up in the Inſide of the Harbour, in order more effectually to view and examine the State thereof, and to enable the Engineers to conſtruct ſuch freſh Works, as might appear neceſſary for the Re-eſtabliſhment of the Harbour.

From this State the preſent Harbour has been gradually improved; the Entry whereof is defended by two Piers, compoſed chiefly of Wooden Piles, the Inſide filled with rough heavy Stones. After paſſing the Throat or Entry, the Veſſels arrive in a capacious outward Harbour, where they may lay defended from all Winds; but having an open Communication with the Sea, the Water flows and ebbs therewith; and at Low-Water Spring-Tides the whole is left dry. Above this, the natural Capacity of the Harbour (as it ſeems) is divided by a Dam, or, as it is called, the *Croſs-Wall*; in which is an Opening

of

of 38 Feet wide at Top, and about 36 at Bottom; and in this is placed a large Pair of Gates pointing to Landward, through which Veſſels at High-water may paſs out of the exterior Harbour into the interior Harbour, or Baſon as it is called, where occaſionally they are kept afloat.

This Croſs-Wall, beſides the Great Gates, has two other Openings of about 12 Feet wide, in each of which is placed a Pair of Draw Gates.

The interior Harbour, or Baſon, is again divided by a ſecond Dam or Croſs-Wall, having an Opening of more than 20 Feet for the Paſſage of ſmaller Veſſels, which is alſo furniſhed with a Pair of Gates pointing to Landward: This Dam has likewiſe another Opening, furniſhed with three Draw Gates, by which the Water can occaſionally be let off ſo as to ſcour the Baſon. Into this upper Reſervoir, which is called the *Pent*, the freſh-water River, which ſprings from the Chalk-Hills North of *Dover*, empties itſelf, and makes its way through both Sets of Gates, through all the three Harbours, and laſtly betwixt the Pier-Heads to the Sea.

This general Diſpoſition of the Harbour appears to me as judicious as can be contrived, and is upon the ſame general Idea as the Port of *Cherbourg*, upon which the *French* had expended an immenſe Sum of Money, in order to complete every Thing in the moſt ſubſtantial Manner, before it was deſtroyed by the *Engliſh* in the laſt War.

According to this Diſpoſition, when by hard Gales of Wind, and Seas from the South-weſtern Quarter, a Quantity of Beach is brought round the Weſtern Head, and lodges itſelf between the Heads; the Baſon and Pent are then filled, partly by taking in the Sea-water, and partly by freſh Water afforded by the River; and there retained till it be low Water. The Draw Gates of the Sluices in the Croſs-Wall are then opened with all poſſible Expedition, and the Body of Water contained in the Baſon and Pent, by making its Way between the Pier-Heads, cuts down and removes the Bar of Beach; which at the Time of Spring-Tides, is done with ſo great Effect, that at one ſingle Operation, as I am informed, a good Paſſage is opened for Veſſels; and at two Tides the whole Mouth of the Harbour can be cleared: And could this be done with equal Eaſe and Expedition at all Times when wanted, then would the Evils that are now complained of not ſubſiſt; and this Port would then

be in nearly the beſt Condition its Situation is capable of, and which indeed is very reſpectable as a Tide Harbour, having a good Capacity, with from 16 to 18 Feet Water at common Spring, and from 11 to 13 Feet Water at common Neap Tides; but it ſo happens, when there are Storms or hard Gales of Wind from the South-weſtern Quarter, and at the ſame Time ſhort or low Neap-Tides, that ſuch a Quantity of Beach will be lodged between the Pier-Heads, and to ſo great an Height, that, according to my Information, a Veſſel drawing but 4 Feet Water can hardly get into or out of the Port, at a Time when, if the Mouth is clear as uſual, there would be good 10 or 11 Feet Water into and out of the Harbour.

At thoſe Times there remains at Low-water ſo great a Depth without the Heads, that the Water from the Sluices has not a ſufficient Fall and Power to drive out the Beach from between the Heads, but it is obliged to lay till the Spring-Tides come on; which, as it may ſometimes happen to be an Interval of a Week, produces great Obſtruction to the Pacquets eſtabliſhed between *Dover* and *Calais*, as well as to the mercantile Trade of the Place, and yet more to general Trade, as Veſſels may want the Port for Safety during theſe Intervals, but cannot enter it.

The Remedy for this Evil, or as far as it is capable of Remedy, is, as I apprehend, the Object of the preſent Enquiry; and towards this End two general Methods preſent themſelves; *viz.*

1ſt, The Prevention of the Beach from getting into the Harbour's Mouth; and,

2dly, A more effectual Way of clearing it out, when it happens to get in at the Times above ſpecified.

If the Purpoſe can be fully effected by either of theſe, or both together, this is the very Thing to be deſired.

It has long been obſerved, that when, by the Waſhing of the Sea at the Foot of the Chalk Cliffs, any conſiderable Fall of the Cliffs happens to the Weſtward of the Port, that this Ground, ſo fallen, making a projecting Point, or Promontory, further out than uſual, ſtops the Courſe of the Beach Coaſtwiſe; ſo that when the Quantity which happens to be laid Eaſtward of the Falls,

Falls, as they are called, has got beyond the Port, the Quantity paſſing the Pier-Heads is ſo ſmall, that the Port is very little annoyed therewith; but as theſe Falls are chiefly compoſed of Chalk, and much broke by the Shock in falling, the Sea in the Courſe of a few Years waſhes them away; and then not only the Beach is let to paſs in its ordinary Quantity, but alſo the Quantity before retained by the Fall; which gradually eſcapes as the Fall, or artificial Point, waſhes away. This has given Occaſion to a Suppoſition, that if, inſtead of theſe temporary Promontories (which are often ſo conſiderable as to cover ſome Acres of Ground) fixed Heads or Jetties were run out into the Sea, which were not capable of being waſhed away, that then theſe Jetties would for ever prevent the Beach from getting Eaſtward into the Harbour; for, ſay they, ſo long as theſe Falls, or natural Jetties, laſt, ſo long is the Harbour free from Beach, eſpecially in ſuch Quantity as to prevent its being eaſily kept clear by running the Sluices, and therefore is no Annoyance thereto. This Matter, as it depends upon Facts that are in themſelves at firſt Sight ſtriking, and therefore ſtrongly inſiſted upon by many, I ſhall endeavour to ſet in a clear Light.

When I was at *Dover*, in the Month of *February* laſt, a very large Fall, about three Miles to the Weſtward of that Port, had happened but a little while before; as well as another large one nearer to *Dover*, which had happened ſome Time preceding that; both theſe Falls I went to view, and conſidered very attentively: I judged that the great Fall, as had been repreſented, covered 6 or 8 Acres of Ground; and will undoubtedly take a conſiderable Time to waſh it away. I obſerved that the Quantity of Beach lining the Shore gradually diminiſhed as we approached both theſe Falls from the Eaſtward; ſo that near thereto the Shore was in a Manner clear of Beach on the Eaſt Side, while there appeared to be a Quantity gathering on the Weſt Sides, and which was in a State of Increaſe; as muſt neceſſarily happen by the gradual Approach of the Beach from the Weſtward.

Undoubtedly, till thoſe Promontories get charged to the full with Beach, the greateſt Part will be there retained; and in conſequence, the conſtant Supply being cut off, the Quantity Eaſtward of the Fall will gradually diminiſh, by removing ſtill further Eaſt. That theſe Falls, if rendered permanent, would permanently retain a Quantity of Beach ſufficient to charge them, and in Conſequence make an Addition to the Coaſt for ſome Space Weſtward thereof,

thereof, I can readily admit; but that, after they are full charged with Beach, they will continue to ſtop the conſtant Supply from getting round theſe Heads, and again driving along the Coaſt Eaſtward, as it had done before, is what is by no Means clear to me. The Matter rather preſents itſelf to me in this Light; that in Fact, by ſuch Time as theſe Falls get fully charged with Beach, or perhaps ſooner, they get ſo far waſhed away as to begin to loſe it again; and as, by this Means, their Powers of Retention, *after they are full*, never come to the Proof, this makes it to be imagined, that the Beach begins to move Eaſtward, merely in conſequence of the Falls waſhing away; and therefore, had the Point been permanent, the Beach would always have been ſtopped.

That the Time taken up in the waſhing away of theſe Falls may in ſome Meaſure correſpond with the Time they take to fill, appears hence, that the largeſt Falls are the longeſt in waſhing away; but then they will confine and lodge more Beach before they are full. I can therefore readily admit, that if Jetties were run out to the ſame Length as thoſe Falls, that if properly maintained they would permanently retain a *certain Quantity*, without afterwards letting that Quantity go again, as the temporary Falls or Jetties now do: but as I am no-ways convinced that they would tend to ſtop the conſtant Succeſſion of Beach from getting round their Heads after they are full, and then drive along the Coaſt as before; I am therefore of Opinion, that the Good that is to be got to *Dover* Harbour, by raiſing artificial Jetties in order to lock up a certain Quantity of Beach, as in a Cheſt, will be no-ways adequate to the Expence of raiſing them; but that the ſucceſſive Quantity will in Fact fill them as faſt as they can be carried out by Men's Hands; ſo that a Remedy this Way muſt conſiſt in an eternal Work of building Jetties; which, as they will require maintaining as well as building, will, together with the common Repairs of the Harbour Works, induce a very great Expence.

It is ſaid indeed, that though the Heads may not retain the Beach beyond a certain Quantity, yet that if it is obliged to go out into deep Water, that it will be loſt in the Sea, and never return upon the Coaſt; but in anſwer to this, I fear it will not be poſſible by the Hands of Man to carry out thoſe Jetties into ſuch deep Water, upon this ſloping Coaſt, as to prevent their Return: Nor indeed, when I obſerve how oddly this Beach gets along the Coaſt, through Paſſes where it muſt go through deep Water, and afterwards

appears

appears again, I am not inclined to truſt altogether to the Shoving it out into deep Water, even if it could be done. I am therefore more ſtrongly induced, (without neglecting any Advantages that may be drawn from thoſe caſual and temporary Reliefs of Nature, the Falls,) to confine my Views, Operations, and Expence, to ſuch Purpoſes as have a determinate End; and which ſuppoſe the beſt to be made of it that can be, under a Suppoſition of a conſtant Succeſſion of Beach from Weſt to Eaſtward upon the Coaſt, as heretofore.

Conformable to this Doctrine of the Movement of the Beach, may be reckoned the real Benefit found by the Jetty that has been erected at the Caſtle Point. It ſeems that formerly the Breadth of Ground between the Pent and the Sea was ſo narrow, that there was great Danger of the Sea's making a thorough Breach into it; but that, upon a large Fall happening at the Caſtle Point, a Quantity of Beach was lodged, and the Partition between the Pent and the Sea was greatly ſtrengthened, ſo long as the Fall laſted; but, upon the Waſhing away of this Fall, the Barrier was again greatly weakened, which being obſerved, an artificial Pier or Jetty was erected at the ſame Place; and ever ſince the Beach has been ſo far retained as to lay in a conſiderable Breadth and Strength between the Pent and the Sea, and ſo as to put that Matter out of all Danger. This was certainly a very judicious Piece of Work, and the Effect was fully accompliſhed, that is, of retaining a Quantity of Beach to the Weſtward of it, ſo as to make an *Addition to the Coaſt:* But this being once made, to as great a Degree as the Projection of this Head is capable of retaining it, the further Quantity coming from the Weſt, and paſſing by the Mouth of *Dover* Harbour, is not retained by this Head, but gets round it, is again gradually waſhed up upon the Shore, and purſues its former Courſe, and probably gets round all the Heads, and forms the Beach in the *Downs*.

To the Weſtward of the Harbour's Mouth is erected a Pier, Jetty, or Breakwater, called *Cheeſeman's Head*, whoſe Effect has likewiſe been to lock up a Quantity of Beach, and thereby making an Addition to the Coaſt. While this was doing, the good Effect thereof to the Harbour was experienced; but being now in a State of Decay, the Beach it formerly retained is coming down; however, as the natural Supply will undoubtedly be cut off for ſome Time by the Falls to the Weſt, it ſeems to me, on mature Conſideration, to be more adviſable to take the Benefit of this Intermiſſion, and to employ the preſent

Powers in raiſing a Work that will more permanently and directly tend to the Relief of the Harbour, than in the repairing *Cheeſeman's Head.*

The natural Direction of the Entry of the Harbour is S. E. by the preſent Magnetic Meridian, or about E. S. E. by the true Meridian; but, to avoid Confuſion, I ſhall confine myſelf, in the Mention of the Points of the Compaſs, to the Magnetic Bearings only.—The Shape of the Weſtern Head is not only very uncommon, but to me very extraordinary; for, after it has been carried out in the natural Direction of the Harbour's Entry for about 30 Feet, in a Line at or about S. S. E. it ſuddenly turns away to S. S. W. in which Direction being carried on between 60 and 70 Feet, it is terminated with a ſalient Angle pointing to the ſame Quarter. The Line of Direction of this Flank of the Pier being continued in an oppoſite Direction, cuts within the Eaſtern Pier-Head about 60 Feet; ſo that, with all Winds betwixt S. S.W. and E. S. E. this Flank is ſtruck obliquely by the Seas, and acts in the Manner of a Tunnel towards bringing the Seas (with Wind from S. to S. S. W.) and conſequently the Beach that happens to be lodged before the Mouth of the Harbour, directly into the Throat thereof. The South-eaſtern Seas indeed are ſo ſhort that they do not much affect the Mouth of this Harbour any Way; but, by the Pier's turning ſo much to the Weſt, it greatly facilitates the Beach, after it has got round its ſalient Point, in getting along this Flank; whoſe Line of Direction being overlapped, as already pointed out, by the Eaſtern Head, is thereby equally caught and retained when the Wind is more to the Weſt than the S. S. W. Direction of this Flank; for it is very obſervable that the Seas will wrap themſelves round an Head, and act with great Power, ſeveral Points of the Compaſs from the Wind that cauſes it. Nothing therefore, as it ſeems to me, could have been formed more improperly, with reſpect to the bringing of Beach into the Throat of the Harbour; nor indeed in all Southerly Winds, with reſpect to bringing in the Seas into the Harbour, had not this laſt Effect been in ſome Meaſure prevented by the Jetty or Tongue projected from the Eaſtern Pier at the inner Entry into the Harbour, which catches them as they run alongſide of the Eaſtern Pier.

I would therefore adviſe, by Way of leſſening as much as poſſible the Quantity of Beach that can get round and lodge between the Pier-Heads, and as the firſt and moſt important Work that can be done, to prolong or carry out the

the firſt-mentioned Line of the Head, in its Direction S. S. E. and that far enough to come into a S. S. W. Direction from the Extremity of the Eaſt Head, which will be done by extending this Face about 90 Feet, as ſhewn in the Plan hereto annexed, and then returning the Outſide ſo as to fall in with the ſalient Point of the preſent Pier. The additional Work will form a Sort of Triangle, whoſe Baſe will be principally formed by the preſent S. S. W. Flank; and whoſe Pojection forward toward the S. E. in a Line perpendicular to the Baſe, will be but little above 60 Feet further out than at preſent. By this Conſtruction, all the Good that ariſes from the Shape of the preſent Pier-Head, in regard to locking in the Beach, will be retained; and as all Winds that are farther out than S. S. W. (that is, than South of the true Meridian) which include all thoſe the moſt prejudicial, will meet the Out-face of the new Work obliquely, they will rather tend to ſend the Seas and Beach to Seaward, than to bring it round the Head into the Throat of the Harbour; and as to all thoſe Winds that are Eaſtward of the S. S. W. they are found to be productive of no ill Effect upon this Harbour. The Intent then of this Projection is not by Way of lengthening the Head, ſo as to make it lock in or retain a greater Quantity of Beach; but by making it to overlap the Eaſtern Head ſufficiently to cauſe the Beach brought Coaſtwiſe, by the great Seas at W. S. W. to ſhoot beyond the Eaſtern Head before it is brought up again upon the Shore, and by giving it ſuch a Shape as ſhall alſo tend, in the moſt effectual Manner poſſible, to make the Beach drive out to Sea, till it has paſſed the Harbour's Mouth.

I am ſenſible at the ſame Time, that neither this nor any other Shape or Prolongation of the Piers will totally prevent the Beach from coming into the Harbour's Mouth; for though this Reaſoning would hold good, in Caſe the Waves of the Sea were reflected from fixed Objects, like Light from poliſhed Surfaces; yet the Seas, as already obſerved, ſo wrap round the Surfaces of Bodies that oppoſe them, that they will in ſome Degree go round, even while they come into an oppoſite Direction. They may therefore more aptly be compared to the Nature of Sound than Light; yet, as the Groſs and Violence of the Action is ſpent according to the Angles and Directions wherewith they firſt ſtrike, the main Force or Streſs of the Action will conform to thoſe Laws; and hence, (as it may be expected) if Two-thirds of the whole Quantity of Beach that now would lodge itſelf in the Harbour's Mouth, is diverted

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ſo as to paſs by it without entering, it will follow, that the Third will not be of One-ſixth of the evil Conſequence and Inconvenience to the Harbour; and that rendered more eaſily and readily to be removed by the Action of the Sluices.

It is perhaps impoſſible to make a compleat artificial Harbour; for what improves it in one Senſe will often be of Detriment in another: For this Reaſon the main Drift and Purpoſe thereof is to be principally attended to, and, when that is done to as great an Advantage as may be, that Harbour may be ſaid to be in the moſt perfect State its Situation is capable of: I am therefore aware that this Addition to the Head here propoſed may meet with ſome Objection from Seamen; for it may be argued, that the preſent Weſterly Turn of the Head admits Ships coming from the Weſtward with a ſcant Wind at N. N. W. more eaſily and readily to ſhoot up into the Wind, and get between the Heads (from whence they warp into the Harbour) with leſs Riſque of overſhooting their Port, than if this Prolongation was to take Place. To this I anſwer, that, as there is frequently a Bank of Beach lodged high againſt the Pier, in the very Place where the new Work is propoſed, (ready to be driven in between the Heads by the firſt Shift of Wind more Southerly) this will, either by the Reality or the Fear thereof, prevent Veſſels from making the Turn of the Weſt Head ſooner, eſpecially if they have no Pilot on Board, than if this Vacancy was occupied with a ſolid Pier; which they will always have the Advantage of ſeeing above Water, and againſt which, from its Shape and Poſition, no material Quantity of Beach can ever lodge. I muſt alſo obſerve, that, if a Ship is coming up the Channel, intending for this Port, ſhe always has either the Wind large, ſo that ſhe can keep a proper Offing, and alter her Courſe proper to run right into Port; or elſe it is an off-ſhore Wind, where, if ſhe pleaſes, ſhe may drop an Anchor before the Harbour's Mouth, and afterwards warp in.

2dly, It may alſo be alledged, that the preſent Face of the Pier-Head is ſometimes uſeful for Ships to lay alongſide, in order to caſt off when the Wind is fair, to go up or down Channel, and with ſuch a Wind as does not enable her to ſail out of Port; but it may be obſerved in Anſwer, that beſides the Objection, that when a Bank of Beach is lodged here, no Uſe can be made of this Side of the Pier for this Purpoſe, it may be further obſerved, that, for all Ships going Eaſterly, the propoſed Eaſt Face will be better adapted in

Southerly

Southerly Winds than the preſent; and for Ships going Weſterly, a Tranſport Buoy, fixed at a proper Diſtance to South-eaſtward of the Harbour's Mouth, would anſwer far better for this Purpoſe than the preſent Pier; and that, even independent of ſuch a Buoy, there are ſome Winds that the propoſed Face would anſwer to, better for Ships to caſt off from, to proceed Weſterly, than the preſent. I am told that ſuch a Buoy has been formerly fixed and maintained; and it ſeems very adviſable that it ſhould be replaced *.

This in my Opinion is the whole and moſt effectual Means that can be uſed to prevent as much as poſſible the Beach from getting into the Harbour's Mouth. I come now to conſider the moſt effectual Means of removing what does come in.

In the Time of Spring-Tides, as has been already obſerved, there is no Difficulty; and in regard to Neap-Tides, as the Quantity that can get in, will, after the Execution of the propoſed Head, be far leſs than at preſent, it may with more Eaſe be removed even with the preſent Power; but, as that does not ſeem ſufficient to be abſolutely depended upon, I ſhall now ſhew what is, in my Opinion, the moſt effectual Way to improve it.

On *Thurſday* Morning, the 23d of *February*, being the third Day after the Full Moon, a full Head of Water was penned in, and the Turnwater next the Eaſt Pier-Head ſet; I obſerved the State of the Beach about and between the Heads, (and which indeed were tolerably clear) before the Sluices were played at Low-water, in order that I might ſee the Operation thereof. I obſerved that the Gates of the Sluices were five Minutes in drawing, and that the Water took up the ſame Time in getting down from the Sluices to the Pier-Heads; that it was five Minutes more in getting to its full Strength, which continued for about Half an Hour; but after that, though it continued a Quarter of an Hour longer, the Effect was inconſiderable. After the Operation I obſerved, that wherever the Beach had laid in the Way of the Water, that it was greatly reduced, and carried ſo far without the Heads, that the Weſterly Seas would infallibly carry it beyond the Eaſt Head, without returning into the Harbour.

I obſerved that, before the Sluices were drawn, there did not appear to be

* The Prolongation of the Weſt Head, and fixing a Tranſport Buoy, I find was adviſed by Capt. *Perry*, in his Report on this Harbour, 1718.

above ſix or eight Inches of Fall from the Apron of the outmoſt Turnwater to the Sea, and about an equal Declivity from the Stone Apron of the great Gates to the ſaid Turnwater Apron; ſo that, from the Stone Apron of the great Gates to Sea, the Fall could not much exceed a Foot, or at moſt 18 Inches, of Declivity; but this will be variable, according as the Tide ebbs more out: I only beg Leave to obſerve, that this will be the ordinary State of it in Spring-Tides, as the preſent ones were ſaid to be of a middling Kind. I obſerved further, that the Water from the Sluices, when in their full Power, ſcarcely overtopped the Turnwaters, which appeared to be about three feet and an half high; ſo that the Fall of the Water's Surface, from the Turnwater to the Sea, was ſcarcely more than four Feet; and yet in this State the Sluices are capable of keeping the Harbour clear. I was informed that at Neap-Tides ſometimes the Water will ebb down to the Stone Apron of the great Gates, but ordinarily ſo as to leave about 20 Inches upon it, ſcarcely ever more than two Feet, if it is not penned by Beach caſt into the Harbour's Mouth. Hence it appears, that at Neap-Tides there is not above three Feet more Depth of Water at the Harbour's Mouth than at Spring-Tides, and conſequently by a Power of Water that will overtop the Sea-water at Neap-Tides, as much as it now does at Spring-Tides, the Harbour's Mouth might then be cleared as effectually at Neap-Tides as it is now at Spring-Tides; and this would be brought about if the Capacities of the Sluices were doubled; for the ſame Deſcent of the Surface would produce the ſame Velocity and Effect upon the Bottom; and, being confined to the ſame Breadth, a double Quantity of Water would produce a double Height, which would then have as good or better Fall into the Sea, at Neap-Tides, than it now has at Spring-Tides.

It is true, that, being diſcharged in double Quantity, it would be ſpent in Half the Time; ſo that, inſtead of laſting Half an Hour in full Vigour, it would laſt only a Quarter; but as a much greater Body and Weight of Water will act at once, a conſiderable Effect muſt be produced; ſo as greatly to relieve the Harbour's Mouth; and which, though not made perfectly clear till the Approach of Spring-Tides, would, in Conjunction with the Relief that is to be expected from the propoſed Addition to the Weſt Head, prevent its ever being barred up at Neap-Tides, or prevent its Uſe to all middling Veſſels; for even a ſingle Diſcharge of the Sluices, with the Power I have mentioned, would in a Manner remove the Groſs of any Obſtruction that then could happen.

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I was informed, that in Summer they can generally gather a full Baſon and Pent in four Days; and one in a Week in the very drieſt Seaſons and ſhorteſt Tides: If ſo, the Pent might always be kept full againſt Neap-Tides, ſo as to fill the Baſon, or nearly ſo, on ſhutting in the firſt Tide that ſhall happen after the Approach of any Emergence; I ſay the Approach of any Emergence; for when it comes to blow at ſuch Points as are found by Experience to bring in the Beach, it is not neceſſary to wait the Event, but to prepare immediately to get a full Head of Water.

There are two Ways by which the Capacity of the Sluices may be augmented: One is by building a new Tunnel at each End of the preſent Stone Wall. The Width of the preſent Tunnels or Arch-ways for the Draw Gates is 12 Feet; but, as I am perfectly clear that the Advantages of the Sluices do not ſo much depend upon the Length of Time that they play, as upon the great Body that can be at once diſcharged, I would adviſe that the new Tunnels ſhould be of 15 Feet wide each, and not be ſhut by Draw Gates, but by Turning Gates; by which the Water can be inſtantly diſcharged, without Loſs of Time or Addition of Hands. The Execution of this Method will require the moſt Time and Expence, but when done will be moſt durable, and require the leaſt Repairs.

The ſecond Method is by placing Turning Gates in the Great Gates; which can be diſcharged and will operate like the former, and anſwer the End in all Reſpects the ſame. The only Objection to this Method is, that Folding Gates made with Turning Gates incaſed, are not only more expenſive to conſtruct, but leſs durable than Folding Gates made plain and whole; otherwiſe the Buſineſs will be done in this Way at far leſs Expence, and in much leſs Time, than with Stone Tunnels; eſpecially as the Great Gates, having been lately renewed, may be made ſtill to ſerve, by having Turning Gates adapted to them.

As I don't know of any Turning Gates incaſed in Folding Gates in *England*, it perhaps may be doubted whether the Thing be practicable; but for their Information I beg Leave to mention, that this very Thing is done, and practiſed with Succeſs, not only at the *Briel*, but in the Great Gates of the Sluice of *Helvoet* in *Holland*, and made Uſe of for ſcouring the outward Har-

bour and Pier-Heads; and that it was formerly done in the great Sluice of *Mardick*, near *Dunkirk*, before it was demoliſhed by Treaty.

The Sluice of *Helvoet* is 48 Feet wide; the Gates which I ſaw in the Year 1755, by a Date upon them appeared to have been conſtructed in the Year 1722, ſo that they had then been in 33 Years, and were then in perfect good Repair; they had however originally been exceedingly well conſtructed, and very ſtrong. I happened to have an Opportunity of ſeeing the Operation of this Sluice, which I well remember was far beyond the preſent ones at *Dover*; though the Turning Gates, incaſed in the Great Gates, were the only Apertures they had for diſcharging the Water from the Baſon; which, according to my Idea, is much leſs than the *Dover* Baſon and Pent together. The whole Operation was in a Manner over in a Quarter of an Hour.

As therefore this Method can be put in Practice in a ſhorter Time and at a leſſer Expence, I would the rather adviſe it at preſent to be put in Practice, that, when the good Effects thereof are ſeen, the larger and more durable Work in Stone may be doing, while the firſt Pair of Gates are in Wear, and which may afterwards be rechanged to thoſe of the preſent Conſtruction, when the others are accompliſhed.

The Addition to the Weſt Head I would adviſe to be of Stone, which will not only be more durable, and in the End cheaper than Wood, but will probably ſhew the Way of rebuilding the preſent Piers with Stone, as they may occaſionally want it, which it is to be wiſhed had been done at firſt.

The Outſide of the new Work I would propoſe to be conſtructed of *Portland* Blocks, but the Inſide may be done with the large rough Stones that are brought from *Folkſtone*, ſuch as are uſed for filling the preſent Piers. I would however adviſe, that, to the Height of ſix or eight Feet, the South Face of the propoſed Addition may be done with *Corniſh* Moor Stones, as the Expence will not create any material Difference upon the Whole; and which will prevent its being affected by the Beach rubbing againſt it.

It would be beſide the preſent Purpoſe to make out Deſigns for the Execution of the propoſed Works, till the Execution ſhall be reſolved upon; and yet without it, it is not poſſible to come to any compleat Eſtimate; however,

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by Way of giving ſome general Idea of the Expence, I ſuppoſe the Stone Head may be done for the Sum of £. 7500; and the Gates made, upon the Plan I have mentioned, for the Sum of £. 1500, including an Addition to the Apron, to prevent the Action of the Water from gulling the Bottom.

Either the Increaſing the Water-way, or the Addition to the Pier, I expect will be of great Service to the Port; and, as one is chiefly Maſonry and the other Carpentry, if proper Funds can be raiſed, they may be both carried on together; but, if they are carried on ſeparately, I look upon the Alteration of the Head as of the moſt immediate Conſequence and Importance.

It may be proper to ſuggeſt, that, when the Port of *Dover* is, by the Means above ſpecified, put upon the beſt Footing its Situation is capable of (that is, according to the beſt of my Judgment,) I apprehend it will be very eligible to be more frequently uſed by the King's Sloops and leſſer Frigates; and therefore, that for fitting them out it would be very practicable to build a Dock in the Place now called the *Paradiſe Pent*, which is in a Manner a waſte Piece of Ground, and where the Excavation for the Purpoſe is in a great Meaſure ready; this having been in ancient Times, as I underſtand, a very material Part of the Harbour.

Auſthorpe, 17th *June*, 1769.

J. SMEATON.

FINIS.